

SMOS/SMAP SYNERGY FOR SMAP LEVEL 2 SOIL MOISTURE ALGORITHM EVALUATION

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Soil Moisture Active Passive (SMAP)* satellite has been proposed to provide global measurements of soil moisture and land freeze/thaw state at 10 km and 3 km resolutions, respectively. SMAP would also provide a radiometer-only soil moisture product at 40-km spatial resolution. This product and the supporting brightness temperature observations are common to both SMAP and European Space Agency's Soil Moisture and Ocean Salinity (SMOS) mission. As a result, there are opportunities for synergies between the two missions. These include exploiting the data for calibration and validation and establishing longer term L-band brightness temperature and derived soil moisture products. In this investigation we will be using SMOS brightness temperature, ancillary data, and soil moisture products to develop and evaluate a candidate SMAP L2 passive soil moisture retrieval algorithm. This work will begin with evaluations based on the SMOS product grids and ancillary data sets and transition to those that will be used by SMAP.

An important step in this analysis is reprocessing the multiple incidence angle observations provided by SMOS to a global brightness temperature product that simulates the constant 40 degree incidence angle observations that SMAP will provide. The reprocessed brightness temperature data provide a basis for evaluating different SMAP algorithm alternatives. Several algorithms are being considered for the SMAP radiometer-only soil moisture retrieval. In this first phase, we utilized only the Single Channel Algorithm (SCA), which is based on the radiative transfer equation and uses the channel that is most sensitive to soil moisture (H-pol). Brightness temperature is corrected sequentially for the effects of temperature, vegetation, roughness (dynamic ancillary data sets) and soil texture (static ancillary data set). European Centre for Medium-Range Weather Forecasts (ECMWF) estimates of soil temperature for the top layer (as provided as part of the SMOS ancillary data) were used to correct for surface temperature effects and to derive microwave emissivity. ECMWF data were also used for precipitation forecasts, presence of snow, and frozen ground. Vegetation options are described below.

One year of soil moisture observations from a set of four watersheds in the U.S. were used to evaluate four different retrieval methodologies: (1) SMOS soil moisture estimates (version 400), (2) SCA soil moisture estimates using the SMOS/SMAP data with SMOS estimated vegetation optical depth, which is part of the SMOS level 2 product, (3) SCA soil moisture estimates using the SMOS/SMAP data and the MODIS-based vegetation climatology data, and (4) SCA soil moisture estimates using the SMOS/SMAP data and actual MODIS observations.

The use of SMOS real-world global microwave observations and the analyses described here will help in the development and selection of different land surface parameters and ancillary observations needed for the SMAP soil moisture algorithms. These investigations will greatly improve the quality and reliability of this SMAP product at launch.

⁷The SMAP mission has not been formally approved by NASA. The decision to proceed with the mission will not occur until the completion of the National Environmental Policy Act (NEPA) process. Discussions in this paper related to SMAP are being made available for information purposes only.